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(54) **DEVICE, SYSTEM AND METHOD OF COMMUNICATING UPPER-LAYER PROTOCOL INFORMATION**

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H04W 72/00	(2009.01)
H04L 29/12	(2006.01)
H04W 12/04	(2009.01)

(52) **U.S. Cl.**

CPC ***H04L 29/0653*** (2013.01); ***H04L 61/6022*** (2013.01); ***H04L 69/22*** (2013.01); ***H04W 12/04*** (2013.01); ***H04W 72/005*** (2013.01)

(58) **Field of Classification Search**

CPC .. C04B 40/0039; H04W 16/14; H04W 48/16; H04W 76/023

See application file for complete search history.

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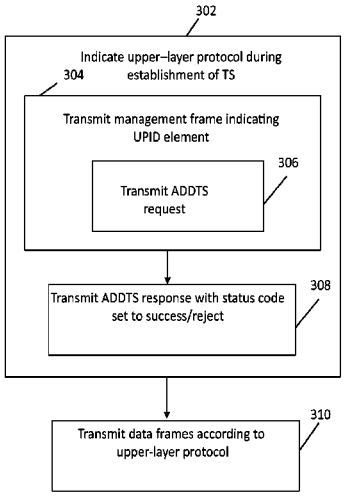
(57) **ABSTRACT**

Some demonstrative embodiments include devices, systems and/or methods of communicating upper-layer protocol information. For example, a wireless communication unit to transmit a management frame, e.g., a Traffic Stream Establishment (TSE) frame, including an Upper-Layer-Identification (UPID) element including a control field indicating a protocol of a layer higher than a Media-Access-Control (MAC) layer.

23 Claims, 3 Drawing Sheets



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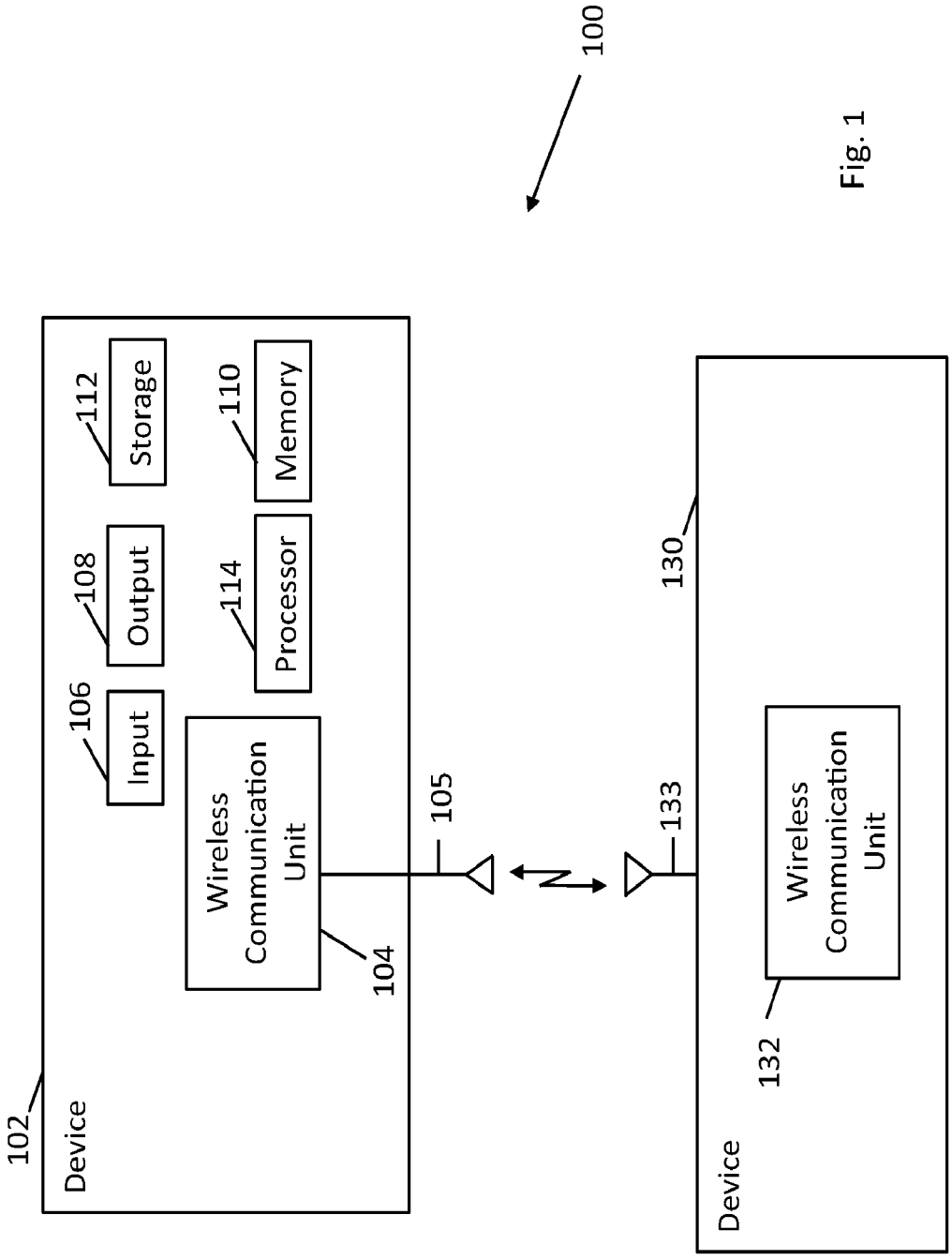
100
102
Device
112
Storage
110
Memory
108
Output
114
Processor
106
Input
Wireless Communication Unit
104
105
133
130
Wireless Communication Unit
132
Device

Fig. 1

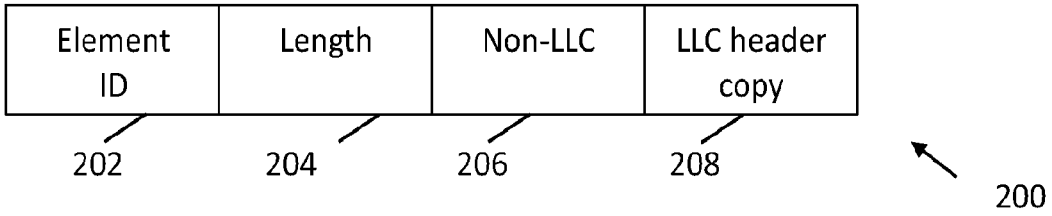
Element ID
Length
Non-LLC
LLC header copy
202
204
206
208
200

Fig. 2

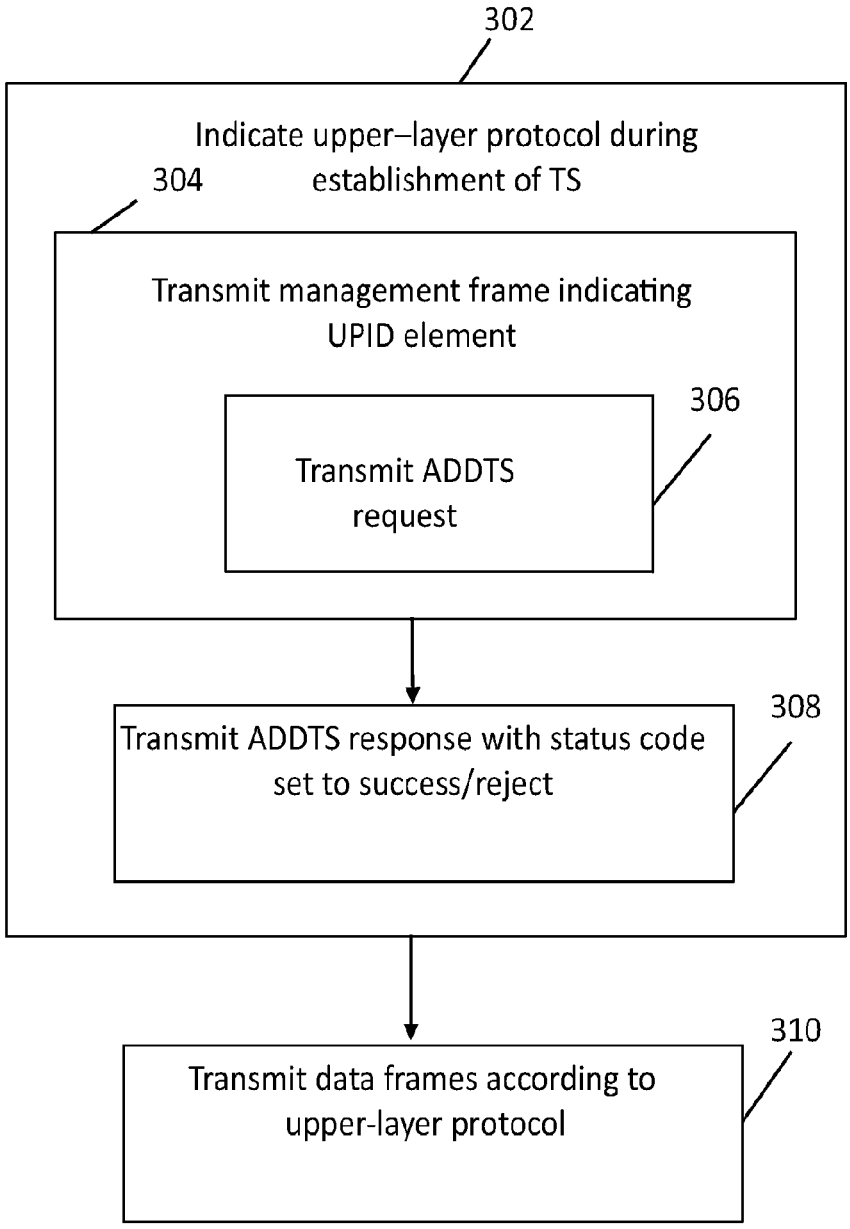
302
Indicate upper–layer protocol during establishment of TS
304
Transmit management frame indicating UPID element
306
Transmit ADDTS request
308
Transmit ADDTS response with status code set to success/reject
310
Transmit data frames according to upper-layer protocol

Fig. 3

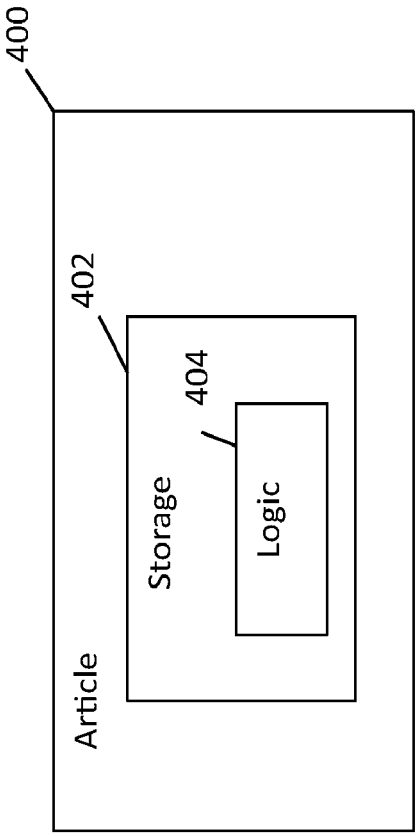

Fig. 4

DEVICE, SYSTEM AND METHOD OF COMMUNICATING UPPER-LAYER PROTOCOL INFORMATION

CROSS REFERENCE

This application claims the benefit of and priority from U.S. Provisional Patent application No. 61/380,379, entitled "Method System and Apparatus for Communication At Wireless Link", filed Sep. 7, 2010, the entire disclosure of which is incorporated herein by reference.

BACKGROUND

A first wireless communication device may transmit one or more data packets to a second wireless communication device.

Each data packet typically includes a header, e.g., a Logical Link Control (LLC) header, which includes information defining an upper-layer protocol to be used for processing the packet. The length of the LLC header is, for example, eight bytes.

BRIEF DESCRIPTION OF THE DRAWINGS

For simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity of presentation. Furthermore, reference numerals may be repeated among the figures to indicate corresponding or analogous elements. The figures are listed below.

FIG. **1** is a schematic block diagram illustration of a system in accordance with some demonstrative embodiments.

FIG. **2** is a schematic illustration of an upper-layer protocol identification element, in accordance with some demonstrative embodiments.

FIG. **3** is a schematic illustration of a method of wireless communication, in accordance with some demonstrative embodiments.

FIG. **4** is a schematic illustration of an article of manufacture, in accordance with some demonstrative embodiments.

DETAILED DESCRIPTION

In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of some embodiments. However, it will be understood by persons of ordinary skill in the art that some embodiments may be practiced without these specific details. In other instances, well-known methods, procedures, components, units and/or circuits have not been described in detail so as not to obscure the discussion.

Discussions herein utilizing terms such as, for example, "processing", "computing", "calculating", "determining", "establishing", "analyzing", "checking", or the like, may refer to operation(s) and/or process(es) of a computer, a computing platform, a computing system, or other electronic computing device, that manipulate and/or transform data represented as physical (e.g., electronic) quantities within the computer's registers and/or memories into other data similarly represented as physical quantities within the computer's registers and/or memories or other information storage medium that may store instructions to perform operations and/or processes.

The terms "plurality" and "a plurality" as used herein include, for example, "multiple" or "two or more". For example, "a plurality of items" includes two or more items.

Some embodiments may be used in conjunction with various devices and systems, for example, a Personal Computer (PC), a desktop computer, a mobile computer, a laptop computer, a notebook computer, a tablet computer, a server computer, a handheld computer, a handheld device, a Personal Digital Assistant (PDA) device, a handheld PDA device, an on-board device, an off-board device, a hybrid device, a vehicular device, a non-vehicular device, a mobile or portable device, a consumer device, a non-mobile or non-portable device, a wireless communication station, a wireless communication device, a wireless Access Point (AP), a wired or wireless router, a wired or wireless modem, a video device, an audio device, an audio-video (A/V) device, a wired or wireless network, a wireless area network, a Wireless Video Area Network (WVAN), a Local Area Network (LAN), a Wireless LAN (WLAN), a Personal Area Network (PAN), a Wireless PAN (WPAN), devices and/or networks operating in accordance with existing Wireless-Gigabit-Alliance (WGA) specifications (*Wireless Gigabit Alliance, Inc WiGig MAC and PHY Specification Version* 1.0, *April* 2010, *Final specification*) and/or future versions and/or derivatives thereof, devices and/or networks operating in accordance with existing IEEE 802.11 standards (*IEEE* 802.11-2007, *IEEE Standard for Information Technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements, Part* 11: *Wireless LAN Medium Access Control* (*MAC*) *and Physical Layer* (*PHY*) *Specifications; IEEE* 802.11*n*-2009, *IEEE Standard for Information Technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements, Part* 11: *Wireless LAN Medium Access Control* (*MAC*) *and Physical Layer* (*PHY*) *specifications, Amendment* 5: *Enhancements for Higher Throughput; IEEE*802.11 task group ac (TGac) ("*IEEE*802.11-09/0308*r*12—*TGac Channel Model Addendum Document*"), *IEEE* 802.11 *task group ad* (*TGad*)) (*IEEE P*802.11*ad*/*D*1.0 *Draft Standard for Information Technology—Telecommunications and Information Exchange Between Systems—Local and Metropolitan Area Networks—Specific Requirements—Part* 11: *Wireless LAN Medium Access Control* (*MAC*) *and Physical Layer* (*PHY*) *Specifications—Amendment* 5: *Enhancements for Very High Throughput in the* 60 *GHz Band*), and/or future versions and/or derivatives thereof, devices and/or networks operating in accordance with existing IEEE 802.16 standards (*IEEE-Std* 802.16, 2009 *Edition, Air Interface for Fixed Broadband Wireless Access Systems; IEEE-Std* 802.16*e,* 2005 *Edition, Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands; amendment to IEEE Std* 802.16-2009, developed by Task Group m) and/or future versions and/or derivatives thereof, devices and/or networks operating in accordance with existing WirelessWirelessHD™ specifications and/or future versions and/or derivatives thereof, units and/or devices which are part of the above networks, one way and/or two-way radio communication systems, cellular radio-telephone communication systems, a cellular telephone, a wireless telephone, a Personal Communication Systems (PCS) device, a PDA device which incorporates a wireless communication device, a mobile or portable Global Positioning System (GPS) device, a device which incorporates a GPS receiver or transceiver or chip, a device which incorporates an RFID element or chip, a Multiple Input Multiple Output (MIMO) transceiver or device, a Single Input Multiple Output (SIMO) transceiver or device, a

Multiple Input Single Output (MISO) transceiver or device, a device having one or more internal antennas and/or external antennas, Digital Video Broadcast (DVB) devices or systems, multi-standard radio devices or systems, a wired or wireless handheld device (e.g., BlackBerry, Palm Treo), a Wireless Application Protocol (WAP) device, or the like.

Some embodiments may be used in conjunction with one or more types of wireless communication signals and/or systems, for example, Radio Frequency (RF), Infra Red (IR), Frequency-Division Multiplexing (FDM), Orthogonal FDM (OFDM), Time-Division Multiplexing (TDM), Time-Division Multiple Access (TDMA), Extended TDMA (E-TDMA), General Packet Radio Service (GPRS), extended GPRS, Code-Division Multiple Access (CDMA), Wideband CDMA (WCDMA), CDMA 2000, single-carrier CDMA, multi-carrier CDMA, Multi-Carrier Modulation (MDM), Discrete Multi-Tone (DMT), Bluetooth®, Global Positioning System (GPS), Wi-Fi, Wi-Max, ZigBee™, Ultra-Wideband (UWB), Global System for Mobile communication (GSM), 2G, 2.5G, 3G, 3.5G, Enhanced Data rates for GSM Evolution (EDGE), or the like. Other embodiments may be used in various other devices, systems and/or networks.

The term "wireless device" as used herein includes, for example, a device capable of wireless communication, a communication device capable of wireless communication, a communication station capable of wireless communication, a portable or non-portable device capable of wireless communication, or the like. In some demonstrative embodiments, a wireless device may be or may include a peripheral that is integrated with a computer, or a peripheral that is attached to a computer. In some demonstrative embodiments, the term "wireless device" may optionally include a wireless service.

Some demonstrative embodiments may be used in conjunction with suitable limited-range or short-range wireless communication networks, for example, a wireless area network, a "piconet", a WPAN, a WVAN and the like. Other embodiments may be used in conjunction with any other suitable wireless communication network.

Some demonstrative embodiments may be used in conjunction with a wireless communication network communicating over a frequency band of 60 GHz. However, other embodiments may be implemented utilizing any other suitable wireless communication frequency bands, for example, an Extremely High Frequency (EHF) band (the millimeter wave (mmwave) frequency band), e.g., a frequency band within the frequency band of between 30 Ghz and 300 GHZ, a WLAN frequency band, a WPAN frequency band, a frequency band according to the WGA specification, and the like.

The term "antenna", as used herein, may include any suitable configuration, structure and/or arrangement of one or more antenna elements, components, units, assemblies and/or arrays. In some embodiments, the antenna may implement transmit and receive functionalities using separate transmit and receive antenna elements. In some embodiments, the antenna may implement transmit and receive functionalities using common and/or integrated transmit/receive elements. The antenna may include an antenna covered by a quasi-omni antenna pattern. For example, the antenna may include at least one of a phased array antenna, a single element antenna, a set of switched beam antennas, and the like.

The phrase "quasi-omni antenna pattern", as used herein, may include an operating mode with a widest practical beamwidth attainable for a particular antenna.

The term "station" (STA), as used herein, may include any logical entity that is a singly addressable instance of a medium access control (MAC) and a physical layer (PHY) interface to a wireless medium (WM).

The phrase "access point" (AP), as used herein, may include an entity that contains one station (STA) and provides access to distribution services, via the WM for associated STAs.

The term "association", as used herein may relate to a service used to establish access point/station (AP/STA) mapping and enable STA invocation of distribution system services (DSSs).

The term "authentication", as used herein may relate to a service used to establish the identity of one station (STA) as a member of the set of STAs authorized to associate with another STA.

The term "beamforming", as used herein, may relate to a spatial filtering mechanism, which may be used at a transmitter to improve the received signal power or signal-to-noise ratio (SNR) at an intended receiver.

The phrase "non-access-point (non-AP) station (STA)", as used herein, may relate to a STA that is not contained within an AP.

The phrase "service period" (SP), as used herein, may relate to a contiguous time during which one or more downlink individually addressed frames are transmitted to a quality of service (QoS) station (STA) and/or one or more transmission opportunities (TXOPs) are granted to the same STA.

The phrase "directional band" (DBand), as used herein, may relate to a frequency band wherein the Channel starting frequency is above 45 GHz.

The phrase "Ultra Band (UB)" may relate to the frequency band of 57-66 GHz.

The phrase "mmWave STA (STA)" may relate to a STA having a radio transmitter, which is operating on a channel that is within the UB.

The phrase "personal basic service set" (PBSS), as used herein, may relate to a basic service set (BSS) that forms a self-contained network. For example, the PBSS may operate in the DBand, and may include one PBSS control point (PCP).

The phrase "PBSS control point" (PCP), as used herein, may include an entity that contains one station (STA) and coordinates access to the WM by STAs that are members of a PBSS.

The phrase "non-PCP station (STA)", as used herein, may relate to a STA that is not also a PCP.

The phrase "non-PCP/non-AP station (STA)", as used herein, may relate to a STA that is not a PCP and that is not an AP.

The phrase "PCP/AP", as used herein, may relate to a STA that is a PCP or an AP.

Reference is now made to FIG. **1**, which schematically illustrates a block diagram of a system **100** in accordance with some demonstrative embodiments.

As shown in FIG. **1**, in some demonstrative embodiments, system **100** may include a wireless communication network including one or more wireless communication devices, e.g., wireless communication devices **102** and/or **130**, capable of communicating content, data, information and/or signals over one or more suitable wireless communication links, for example, a radio channel, an IR channel, a RF channel, a Wireless Fidelity (WiFi) channel, and the like. One or more elements of system **100** may optionally be capable of communicating over any suitable wired communication links.

In some demonstrative embodiments, wireless communication devices **102** and/or **130** may include, for example, may include, for example, a PC, a desktop computer, a mobile computer, a laptop computer, a notebook computer, a tablet

computer, a server computer, a handheld computer, a handheld device, a PDA device, a handheld PDA device, an on-board device, an off-board device, a hybrid device (e.g., combining cellular phone functionalities with PDA device functionalities), a consumer device, a vehicular device, a non-vehicular device, a mobile or portable device, a non-mobile or non-portable device, a cellular telephone, a PCS device, a PDA device which incorporates a wireless communication device, a mobile or portable GPS device, a DVB device, a relatively small computing device, a non-desktop computer, a "Carry Small Live Large" (CSLL) device, an Ultra Mobile Device (UMD), an Ultra Mobile PC (UMPC), a Mobile Internet Device (MID), an "Origami" device or computing device, a device that supports Dynamically Composable Computing (DCC), a context-aware device, a video device, an audio device, an AN device, a Set-Top-Box (STB), a Blu-ray disc (BD) player, a BD recorder, a Digital Video Disc (DVD) player, a High Definition (HD) DVD player, a DVD recorder, a HD DVD recorder, a Personal Video Recorder (PVR), a broadcast HD receiver, a video source, an audio source, a video sink, an audio sink, a stereo tuner, a broadcast radio receiver, a flat panel display, a Personal Media Player (PMP), a digital video camera (DVC), a digital audio player, a speaker, an audio receiver, an audio amplifier, a gaming device, a data source, a data sink, a Digital Still camera (DSC), a media player, a Smartphone, a television, a music player, or the like.

In some demonstrative embodiments, wireless communication devices **102** and/or **130** may include wireless communication units **104** and/or **132**, respectively, to perform wireless communication with wireless communication devices **102** and/or **130**, respectively, and/or with one or more other wireless communication devices, e.g., as described below.

Wireless communication devices **102** and/or **130** may also include, for example, one or more of a processor **114**, an input unit **106**, an output unit **108**, a memory unit **110**, and a storage unit **112**. Wireless communication devices **102** and/or **130** may optionally include other suitable hardware components and/or software components. In some demonstrative embodiments, some or all of the components of one or more of wireless communication devices **102** and/or **130** may be enclosed in a common housing or packaging, and may be interconnected or operably associated using one or more wired or wireless links. In other embodiments, components of one or more of wireless communication devices **102** and/or **130** may be distributed among multiple or separate devices.

Processor **114** includes, for example, a Central Processing Unit (CPU), a Digital Signal Processor (DSP), one or more processor cores, a single-core processor, a dual-core processor, a multiple-core processor, a microprocessor, a host processor, a controller, a plurality of processors or controllers, a chip, a microchip, one or more circuits, circuitry, a logic unit, an Integrated Circuit (IC), an Application-Specific IC (ASIC), or any other suitable multi-purpose or specific processor or controller. Processor **114** executes instructions, for example, of an Operating System (OS) of wireless communication devices **102** and/or **130** and/or of one or more suitable applications.

Input unit **106** includes, for example, a keyboard, a keypad, a mouse, a touch-pad, a track-ball, a stylus, a microphone, or other suitable pointing device or input device. Output unit **108** includes, for example, a monitor, a screen, a flat panel display, a Cathode Ray Tube (CRT) display unit, a Liquid Crystal Display (LCD) display unit, a plasma display unit, one or more audio speakers or earphones, or other suitable output devices.

Memory unit **110** includes, for example, a Random Access Memory (RAM), a Read Only Memory (ROM), a Dynamic RAM (DRAM), a Synchronous DRAM (SD-RAM), a flash memory, a volatile memory, a non-volatile memory, a cache memory, a buffer, a short term memory unit, a long term memory unit, or other suitable memory units. Storage unit **112** includes, for example, a hard disk drive, a floppy disk drive, a Compact Disk (CD) drive, a CD-ROM drive, a DVD drive, or other suitable removable or non-removable storage units. Memory unit **110** and/or storage unit **112**, for example, may store data processed by wireless communication devices **102** and/or **130**.

In some demonstrative embodiments, wireless communication units **104** and **132** may include, or may be associated with, one or more antennas **105** and **133**, respectively. Antennas **105** and/or **133** may include any type of antennas suitable for transmitting and/or receiving wireless communication signals, blocks, frames, transmission streams, packets, messages and/or data. For example, antennas **105** and/or **133** may include any suitable configuration, structure and/or arrangement of one or more antenna elements, components, units, assemblies and/or arrays. Antennas **105** and/or **133** may include an antenna covered by a quasi-omni antenna pattern. For example, antennas **105** and/or **133** may include at least one of a phased array antenna, a single element antenna, a set of switched beam antennas, and the like. In some embodiments, antennas **105** and/or **133** may implement transmit and receive functionalities using separate transmit and receive antenna elements. In some embodiments, antennas **105** and/or **133** may implement transmit and receive functionalities using common and/or integrated transmit/receive elements.

In some demonstrative embodiments, wireless communication units **104** and/or **132** include, for example, one or more wireless transmitters, receivers and/or transceivers able to send and/or receive wireless communication signals, RF signals, frames, blocks, transmission streams, packets, messages, data items, and/or data. For example, wireless communication units **104** and/or **132** may include or may be implemented as part of a wireless Network Interface Card (NIC), and the like.

In some demonstrative embodiments, wireless communication devices **102** and **130** may establish a wireless communication link. The link may include an uplink and/or a downlink. The downlink may include, for example, a unidirectional link from an AP to one or more non-AP stations (STAs) or a unidirectional link from a non-AP Destination STA to a non-AP Source STA. The uplink may include, for example, a unidirectional link from a non-AP STA to an AP or a unidirectional link from a non-AP Source STA to a non-AP Destination STA.

In some demonstrative embodiments, wireless communication devices **102** and/or **130** may perform the functionality of mmWave stations ("mSTA").

In some demonstrative embodiments, wireless communication unit **104** may transmit one or more packets to wireless communication unit **132**.

In some demonstrative embodiments, wireless communication unit **104** may transmit a relatively short packet. For example, the packet may have a size of less than 100 bytes, e.g., a size of 64 bytes. According to these embodiments, a length of a header, e.g., a Logical Link Control (LLC) header, which includes information defining an upper-layer protocol to be used for processing the packet, may not be negligible with respect to the length of the packet. For example, the LLC header may have a length of 8 bytes, which may be 12.5% the length of a 64-byte packet. Accordingly, it may be inefficient to include the LLC header as part of the packet

In some demonstrative embodiments, wireless communication unit **104** may be configured to establish a traffic stream to be used for transmitting packets to wireless communication unit **132** and, during establishment of the traffic stream to indicate to wireless communication device **132** a protocol of a communication layer higher than a Media-Access-Control (MAC) layer to be used for processing the packets, e.g., as described in detail below. According to these embodiments, wireless communication unit **104** may transmit the packets according to the protocol, for example, while not including the LLC header in each of the packets.

In some demonstrative embodiments, wireless communication unit **104** may transmit a management frame, e.g., a Traffic Stream Establishment (TSE) frame, to establish a traffic stream with wireless communication unit **132**. The TSE frame may include an Upper-Layer-Identification-Element (UPID) including a control field indicating a protocol ("upper layer protocol") of a layer higher than a Media-Access-Control (MAC) layer, which may be used for processing one or more data frames and/or packets associated with the traffic stream, e.g., as described in detail below.

In some demonstrative embodiments, the TSE frame may include an Add-Traffic-Specification (ADDTS) frame. For example, the ADDTS frame may include an ADDTS request frame or an ADDTS response frame.

In some demonstrative embodiments, after establishing the traffic stream, wireless communication unit **104** may transmit one or more data packets, for example, MAC service data units (MSDUs), configured according to the protocol indicated by the control field.

In some demonstrative embodiments, the control field may include a LLC header field.

In some demonstrative embodiments, the LLC header field may include, for example, a LLC header with eight-bit control field with Sub-Network-Access-Protocol (SNAP), a LLC header with eight-bit control field without SNAP, or a LLC header with sixteen-bit control field, e.g., as described below.

In some demonstrative embodiments, the TSE frame may include a bit indicating whether or not one or more MSDUs are to include the control field, e.g., as described below.

In some demonstrative embodiments, wireless communication unit **132** may determine the upper layer protocol during the establishment of the traffic stream, e.g., based on the UPID of the TSE frame. Wireless communication unit **132** may utilize the upper layer protocol indicated by the UPID for processing one or more packets received from wireless communication unit **104** via the established traffic stream.

Reference is made to FIG. **2**, which schematically illustrates a UPID **200**, in accordance with some demonstrative embodiments. For example, UPID **200** may be included as part of an ADDTS Request frame, an ADDTS Response frame, and the like, which may be exchanged, e.g., between devices **102** and **130** (FIG. **1**), during establishment of a traffic stream.

In some demonstrative embodiments, UPID **200** may include an element ID field **202**, which may have a predefined value indicating that UPID **200** is to be used for upper layer protocol identification. For example, field **202** may have a length of one octet.

In some demonstrative embodiments, UPID **200** may include a length field **204** having a value indicating a length of UPID **200** or the length of one or more fields of UPID **200**, e.g., subsequent to length field **204**. For example, length field **204** may have a length of 1 octet.

In some demonstrative embodiments, UPID **200** may include a No-LLC field **206** having a value indicating whether or not one or more subsequently transmitted MSDUs will include a LLC header. For example, field **206** may be set to a first predefined value, e.g., "1", to indicate that the one or more MSDUs do not include the LLC header. Field **206** may be set to a second predefined value, e.g., "0", to indicate that the one or more MSDUs do include the LLC header. Field **206** may have for example, a length of one octet.

In some demonstrative embodiments, UPID **200** may include a LLC header copy field **208** having a including information indicating an upper layer protocol to be applied to the one or more subsequent MSDUs. For example, field **208** may include a LLC header. Field **208** may be set to "0" if, for example, No-LLC field **206** is set to "0". Field **208** may include, for example, a copy of LLC header field values if, for example, the No-LLC field **206** is set to "1".

In some demonstrative embodiments, a size LLC header copy field **208** may be related to a type of LLC header included in field **208**, e.g., as follows:

TABLE 1

LLC header type	LLC header copy field size (octets)
LLC header with 8-bit control field without Sub-Network-Access-Protocol (SNAP)	3
LLC header with 8 bit field with SNAP	8
LLC header with 16 bit control field	4

For example, field **208** may include the LLC header, e.g., as defined by *IEEE Std* 802.2, 1998 *Edition* (*R*2003)—*IEEE Standard for Information technology Telecommunications and information exchange between systems Local and metropolitan area networks, Specific requirements*, and the like.

In other embodiments, field **208** may include any other suitable information, e.g., in addition to or instead of the LLC header and/or any other LLC header type, identifying and/or defining the upper layer protocol.

Referring back to FIG. **1**, in some demonstrative embodiments, wireless communication unit **104** may transmit an ADDTS Request frame including a Traffic Specification (TSPEC) element specifying a Traffic ID (TID) or a Traffic Stream ID (TSID), and a U-PID element, e.g., UPID element **200** (FIG. **2**), to indicate the upper layer protocol associated with the TID or TSID. In other embodiments, the ADDTS request frame may not include the UPID element.

In some demonstrative embodiments, wireless communication unit **104** may transmit an ADDTS Response frame including a TSPEC element specifying a TID or a TSID, and a U-PID element, e.g., UPID element **200** (FIG. **2**), to indicate the upper layer protocol associated with the TID or TSID. The ADDTS response frame may not include the UPID element, for example, if the ADDTS request frame does not include a UPID element.

In some demonstrative embodiments, wireless communication unit **104** may include U-PID element **200** (FIG. **2**) in ADDTS Request and/or ADDTS Response frames transmitted to indicate the protocol responsible for handling MSDUs corresponding to the TID/TSID indicated within the frame carrying the U-PID element.

Wireless communication unit **104** may not include UPID element **200** (FIG. **2**) as part of an ADDTS Request frame, for example, if wireless communication unit **104** is to transmit MSDUs corresponding to the TID/TSID including an LLC protocol header to be used for upper layer protocol selection.

Wireless communication unit **104** may not include UPID element **200** (FIG. **2**) as part of an ADDTS response frame,

for example, if a U-PID element was not included in a corresponding ADDTS Request frame received by wireless communication unit **104**.

In some demonstrative embodiments, if wireless communication unit **104** receives an U-PID element included in an ADDTS Request frame, then wireless communication unit **104** may transmit a ADDTS response frame with a Status Code of success and having a LLC header copy field, e.g., field **208** (FIG. **2**), including the same LLC header copy field included in the UPID element of the ADDTS Request frame.

In some demonstrative embodiments, wireless communication unit **104** may reject the ADDTS request frame, e.g., to reject a setting of the U-PID element received within the ADDTS Request frame. For example, wireless communication unit **104** may set a Status Code field of the ADDTS response frame to REJECT_U-PID_SETTING.

Reference is made to FIG. **3**, which schematically illustrates a method of wireless communication, in accordance with some demonstrative embodiments. In some embodiments, one or more of the operations of the method of FIG. **3** may be performed by any suitable wireless communication system e.g., system **100** (FIG. **1**); wireless communication device, e.g., devices **102** and/or **130** (FIG. **1**); and/or wireless communication unit, e.g., wireless communication units **104** and/or **132** (FIG. **1**).

As indicated at block **302**, the method may include indicating a protocol ("upper layer protocol") of a communication layer higher than a MAC layer during establishment of a traffic stream.

As indicated at block **304**, indicating the upper layer protocol may include transmitting a management frame, e.g., a TSE frame, including a UPID element indicating the upper layer protocol. For example, wireless communication unit **104** (FIG. **1**) may transmit a TSE frame including UPID element **200** (FIG. **2**), e.g., as described above.

As indicated at block **306**, transmitting the TSE frame may include transmitting an ADDTS frame including the UPID element. For example, wireless communication unit **104** (FIG. **1**) may transmit an ADDTS request frame or an ADDTS response frame including UPID element **200** (FIG. **2**), e.g., as described above.

As indicated at block **308**, the method may include receiving a response indicating whether the UPID is confirmed or rejected. For example, wireless communication unit **104** (FIG. **1**) may transmit the ADDTS request including the UPID element and receive a response, e.g., an ADDTS response frame, indicating whether the UPID is confirmed or rejected, e.g., as described above.

As indicated at block **310**, the method may include transmitting one or more data frames according to the upper layer protocol. For example, wireless communication device **104** (FIG. **1**) may transmit one or more MSDUs multiplexed according to the upper layer protocol indicated by the UPID element and/or wireless communication unit **132** (FIG. **1**) may demultiplex the one or more MSDUs according to the upper layer protocol indicated by the UPID element.

Reference is made to FIG. **4**, which schematically illustrates an article of manufacture **400**, in accordance with some demonstrative embodiments. Article **400** may include a machine-readable storage medium **402** to store logic **404**, which may be used, for example, to perform at least part of the functionality of wireless communication unit **104** (FIG. **1**), wireless communication device **102** (FIG. **1**), wireless communication unit **132** (FIG. **1**), wireless communication device **130** (FIG. **1**); and/or to perform one or more operations of the method of FIG. **3**.

In some demonstrative embodiments, article **400** and/or machine-readable storage medium **402** may include one or more types of computer-readable storage media capable of storing data, including volatile memory, non-volatile memory, removable or non-removable memory, erasable or non-erasable memory, writeable or re-writeable memory, and the like. For example, machine-readable storage medium **402** may include, RAM, DRAM, Double-Data-Rate DRAM (DDR-DRAM), SDRAM, static RAM (SRAM), ROM, programmable ROM (PROM), erasable programmable ROM (EPROM), electrically erasable programmable ROM (EEPROM), Compact Disk ROM (CD-ROM), Compact Disk Recordable (CD-R), Compact Disk Rewriteable (CD-RW), flash memory (e.g., NOR or NAND flash memory), content addressable memory (CAM), polymer memory, phase-change memory, ferroelectric memory, silicon-oxide-nitride-oxide-silicon (SONOS) memory, a disk, a floppy disk, a hard drive, an optical disk, a magnetic disk, a card, a magnetic card, an optical card, a tape, a cassette, and the like. The computer-readable storage media may include any suitable media involved with downloading or transferring a computer program from a remote computer to a requesting computer carried by data signals embodied in a carrier wave or other propagation medium through a communication link, e.g., a modem, radio or network connection.

In some demonstrative embodiments, logic **404** may include instructions, data, and/or code, which, if executed by a machine, may cause the machine to perform a method, process and/or operations as described herein. The machine may include, for example, any suitable processing platform, computing platform, computing device, processing device, computing system, processing system, computer, processor, or the like, and may be implemented using any suitable combination of hardware, software, firmware, and the like.

In some demonstrative embodiments, logic **404** may include, or may be implemented as, software, a software module, an application, a program, a subroutine, instructions, an instruction set, computing code, words, values, symbols, and the like. The instructions may include any suitable type of code, such as source code, compiled code, interpreted code, executable code, static code, dynamic code, and the like. The instructions may be implemented according to a predefined computer language, manner or syntax, for instructing a processor to perform a certain function. The instructions may be implemented using any suitable high-level, low-level, object-oriented, visual, compiled and/or interpreted programming language, such as C, C++, Java, BASIC, Matlab, Pascal, Visual BASIC, assembly language, machine code, and the like.

Functions, operations, components and/or features described herein with reference to one or more embodiments, may be combined with, or may be utilized in combination with, one or more other functions, operations, components and/or features described herein with reference to one or more other embodiments, or vice versa.

While certain features of the invention have been illustrated and described herein, many modifications, substitutions, changes, and equivalents may occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

What is claimed is:

1. A device comprising:

a wireless communication unit to transmit an Add-Traffic-Specification (ADDTS) frame, said ADDTS frame including a Traffic Identifier (TID), and an Upper-Layer-Identification (UPID) element including a Logical-

Link-Control (LLC) header field and an indication field, the LLC header field including a LLC header indicating a protocol of a layer higher than a Media-Access-Control (MAC) layer, said indication field being set to indicate that one or more MAC service data units (MSDUs) associated with said TID are to be communicated without the LLC header.

2. The device of claim **1**, wherein said LLC header field includes a LLC header with eight-bit control field with Sub-Network-Access-Protocol (SNAP), a LLC header with eight-bit control field without SNAP, or a LLC header with sixteen-bit control field.

3. The device of claim **1**, wherein said ADDTS frame comprises an ADDTS request frame.

4. The device of claim **3**, wherein said ADDTS request frame includes a Traffic Specification (TSPEC) element specifying said TID.

5. The device of claim **1**, wherein said ADDTS frame comprises an ADDTS response frame.

6. The device of claim **5**, wherein said wireless communication unit is to transmit said ADDTS response frame in response to an ADDTS request frame, said ADDTS response frame including the UPID element, when said ADDTS request frame includes said UPID element.

7. The device of claim **5**, wherein said wireless communication unit is to transmit said ADDTS response frame in response to an ADDTS request frame, the LLC header in said ADDTS response frame being the same as a LLC header in said ADDTS request frame.

8. The device of claim **1**, wherein said wireless communication unit is to transmit the one or more MAC service data units (MSDUs) configured according to the protocol indicated by the LLC header.

9. A method comprising:

generating an Add-Traffic-Specification (ADDTS) frame, said ADDTS frame including a Traffic Identifier (TID), and an Upper-Layer-Identification (UPID) element including a Logical-Link-Control (LLC) header field and an indication field, the LLC header field including a LLC header indicating a protocol of a communication layer higher than a Media-Access-Control (MAC) layer, the indication field being set to indicate that one or more MAC service data units (MSDUs) associated with said TID are to be communicated without the LLC header; and

transmitting the ADDTS frame.

10. The method of claim **9** comprising transmitting the one or more MAC service data units (MSDUs) configured according to the protocol indicated by the LLC header.

11. The method of claim **9**, wherein said LLC header field includes a LLC header with eight-bit control field with Sub-Network-Access-Protocol (SNAP), a LLC header with eight-bit control field without SNAP, or a LLC header with sixteen-bit control field.

12. The method of claim **9**, wherein said ADDTS frame comprises an ADDTS request frame.

13. The method of claim **12**, wherein said ADDTS request frame includes a Traffic Specification (TSPEC) element specifying said TID.

14. The method of claim **9**, wherein said ADDTS frame comprises an ADDTS response frame.

15. The method of claim **14**, comprising transmitting said ADDTS response frame in response to an ADDTS request frame, said ADDTS response frame including the UPID element, when said ADDTS request frame includes said UPID element.

16. The method of claim **14** comprising transmitting said ADDTS response frame in response to an ADDTS request frame, the LLC header in said ADDTS response frame being the same as a LLC header in said ADDTS request frame.

17. A system comprising:

a wireless communication device to establish a traffic stream by transmitting an Add-Traffic-Specification (ADDTS) frame, said ADDTS frame including a traffic stream identification (TSID), and an Upper-Layer-Identification (UPID) element including a Logical-Link-Control (LLC) header field and an indication field, the LLC header field including a LLC header indicating a protocol of a communication layer higher than a Media-Access-Control (MAC) layer for processing one or more MAC service data units (MSDUs) associated with the TSID, the indication field being set to indicate that the one or more MSDUs associated with the TSID are to be communicated without the LLC header.

18. The system of claim **17**, wherein said LLC header field includes a LLC header with eight-bit control field with Sub-Network-Access-Protocol (SNAP), a LLC header with eight-bit control field without SNAP, or a LLC header with sixteen-bit control field.

19. The system of claim **17**, wherein said ADDTS frame comprises an ADDTS request frame.

20. The system of claim **17**, wherein said ADDTS frame comprises an ADDTS response frame.

21. The system of claim **20**, wherein said wireless communication device is to transmit said ADDTS response frame in response to an ADDTS request frame, said ADDTS response frame including the UPID element, when said ADDTS request frame includes said UPID element.

22. The system of claim **20**, wherein said wireless communication device is to transmit said ADDTS response frame in response to an ADDTS request frame, the LLC header in said ADDTS response frame being the same as a LLC header in said ADDTS request frame.

23. The system of claim **17**, wherein said wireless communication device is to transmit the one or more MSDUs configured according to the protocol indicated by the LLC header.

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